

The opinion in support of the decision being entered today was **not** written for publication and is **not** binding precedent of the Board.

Paper No. 38

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte BENJAMIN GEBHART

Appeal No. 1997-3678
Application No. 08/485,161

ON BRIEF¹

Before COHEN, JOHN D. SMITH, and JENNIFER D. BAHR,
Administrative Patent Judges.
COHEN, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 1, 3 through 7, 9, and 34 through 36. These claims constitute all of the claims remaining in the application.

¹ The hearing set for November 1, 1999 was waived by appellant (Paper No. 37).

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Appellant's invention pertains to a method of cooling a surface by nucleate boiling. A basic understanding of the invention can be derived from a reading of exemplary claim 1, a copy of which appears in the APPENDIX to the amended brief (Paper No. 28).

As evidence of anticipation and obviousness, the examiner has applied the documents listed below:

Chu et al. 1977 (Chu)	4,050,507	Sep. 27,
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Reeber et al. 1965 (Reeber)	709,574	May 18,
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Hesketh, Peter J., "THE EMITTANCE OF HEAVILY DOPED MICROCONFIGURED SILICON SURFACES", A DISSERTATION IN ELECTRICAL ENGINEERING, UNIVERSITY OF PENNSYLVANIA, CHAPTER 2, pages 42 through 53, 1987. (the Hesketh dissertation)

Marto, P. J. and Lepere, Lt. V. J., "Pool Boiling Heat Transfer From Enhanced Surfaces to Dielectric Fluids", Transactions of the ASME, Journal of Heat Transfer, Vol. 104, pages 292 through 299, May 1982. (the Marto and Lepere article)

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The following rejections are before us for review.

Claims 1, 3 through 7, 9, and 34 through 36² stand rejected under 35 U.S.C. § 103 as being unpatentable over Reeber in view of Chu, and vice versa, and the Marto and Lepere article and, optionally, the Hesketh dissertation.

Claims 1, 3 through 7, 9, and 34 through 36 stand rejected under 35 U.S.C. § 102(b) as being anticipated or, in the alternative, under 35 U.S.C. § 103 as obvious over the Marto and Lepere article (aged surfaces C and D in Figures 6 through 8).

The full text of the examiner's rejections and response to the argument presented by appellant appears in the answer

² We have corrected the claims specified in the rejection to cover the pending claims obviously intended to be under rejection, consistent with appellant's understanding (amended brief, page 7).

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(Paper No. 29), while the complete statement of appellant's argument can be found in the amended brief (Paper No. 28).³

OPINION

In reaching our conclusion on the issues raised in this appeal, this panel of the board has carefully considered appellant's specification and claims,⁴ the applied teachings,⁵

³ A reply brief submitted by appellant was denied entry for the reasons set forth in the examiner's communication dated July 21, 1999 (Paper No. 35). It follows, of course, that the content of the reply brief is not before us for consideration.

⁴ Claim 3, as it appears in the appendix to the brief as well as in the application file, improperly depends from canceled claim 2. For purposes of this appeal, we shall view claim 3 as if it depended from claim 1. We note that appellant (brief, page 4) describes claim 3 as depending from claim 1. The matter of this improper dependency will be further treated below. Additionally, certain words of degree in the claims may pose an issue of indefiniteness, as further pointed out, infra. Nevertheless, we do understand the claimed invention to the extent that we can assess the prior art rejections on appeal.

⁵ In our evaluation of the applied prior art, we have considered all of the disclosure of each document for what it
(continued...)

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and the respective viewpoints of appellant and the examiner.
As a consequence of our review, we make the determinations
which follow.

⁵(...continued)
would have fairly taught one of ordinary skill in the art.
See In re Boe, 355 F.2d 961, 965, 148 USPQ 507, 510 (CCPA
1966). Additionally, this panel of the board has taken into
account not only the specific teachings, but also the
inferences which one skilled in the art would reasonably have
been expected to draw from the disclosure. See In re Preda,
401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968).

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The rejection under 35 U.S.C. § 103

We reverse this rejection of appellant's claims.

Our focus, in particular, will be upon the particular features of independent claim 1, evaluated relative to the evidence of obviousness.

Claim 1 is drawn to a method of cooling a surface by nucleate boiling comprising, inter alia, providing a polished, photo etched surface containing discrete nucleation sites having a conical cross section, immersing the surface in a refrigerant having a liquid contact angle of less than 5° and a preselected boiling point so that the nucleation sites become substantially flooded by the refrigerant, wherein the conical cross-section has a cavity cone angle, **2**, which is greater than the liquid contact angle, **K**, of the refrigerant, and permitting the surface to heat up to a temperature of at least the preselected boiling point, with said heating initiating nucleate boiling of the refrigerant with a reversal

of trend of less than 2°C and without a temperature overshoot on the initial ascent.⁶

As the answer readily reveals (pages 5 through 15), the examiner has in detail carefully assessed the features of independent method claim 1 relative to the respective teachings of Reeber, Chu, the Marto and Lepere article, and the Hesketh dissertation. Like the examiner, we appreciate the relevance of particular teachings of the evidence of obviousness, as well as deficiencies therein with respect to the overall method of claim 1; more specifically, the deficiency that concerns the recitation in step (c) of claim 1 requiring a reversal of trend of less than 2°C (answer, pages 7 through 10). As candidly acknowledged by the examiner (answer, page 8), "clause (c) of claim 1 represents one of the most troubling aspects of the case." The examiner also brings to our attention (answer, page 8) that claim 1 has evolved to its present form during its prosecution history. We find that

⁶ As argued (brief, page 11), appellant understands the claimed subject matter to recite flooding of nucleation sites with the refrigerant prior to heating the surface to a preselected boiling point of the refrigerant.

method claim 1 on appeal is now quite detailed in requiring the specific step limitations thereof highlighted earlier in this decision.

As indicated above, we fully appreciate from our reading of each of the proffered references the relevant teachings thereof. The Reeber method increases heat transfer from a substrate surface in liquefied helium gas, relying upon the formation of bubbles in conical imperfections in the surface (Fig. 2); the imperfections being made by treating the surface with some tool or molding the imperfections into the surface (page 5). The Chu method customizes nucleate boiling heat transfer wherein boiling is started at a predetermined temperature so that temperature overshoot or hysteresis is prevented (column 2, lines 50 through 54) and column 7, lines 44 through 67); the method relies upon specially shaped nucleation cavities (Fig. 12) effected by a laser beam or E beam equivalent (column 6, lines 39 through 44). As explained by patentee Chu, liquid will fill cavities and no vapor will remain under a specified condition (column 5, lines

4 and 5). The Marto and Lepere article focuses upon pool boiling heat transfer from machined enhanced surfaces (surface cavities) to dielectric fluids. The article explains (page 297) that Thermoexcel E surfaces, in particular, exhibit very little temperature overshoot and hysteresis following surface aging C and D. Comparison Figures 6 through 8 in the article (page 296) address data derived for the alternative procedures of surface aging A, B, C, and D (page 294). The Hesketh dissertation teaches wafers with a polished side, wherein microconfigured structures (the hexagonal microcavities of Figure 2.1; page 44 of the dissertation) are etched into the polished side using standard photolithography.

Notwithstanding, the clear relevance of the above reference disclosures to the method of claim 1, akin to the examiner's understanding of the evidence of obviousness, we perceive a lack of indication or suggestion in the applied prior art for the claimed method feature of the heating of the surface initiating nucleate boiling of the refrigerant with a reversal of trend of less than 2°C and without a temperature overshoot on the initial ascent. Figure 16 graphically

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reveals what is intended by this claimed limitation during the initial ascent. Appellant makes us aware in Table 1 (specification, page 20) that, compared to the measured reversal of trend for the present invention, the reversal of trend with Thermoexcel-E of the Marto and Lepere article (1982) is significantly higher. As this Table indicates appellant's invention yields reversals of trend less than 2°C, as now claimed. The examiner's concern (answer, page 11) regarding what additional testing, vis-a-vis the teachings in the Marto and Lepere, might reveal can only be fairly viewed as speculation. Thus, based upon the evidence before us, we conclude that as to the important specific limitation of a reversal of trend less than 2°C in claim 1, we find that the applied teachings neither teach the limitation nor would have been reasonably suggestive thereof. It follows, therefore, that the rejection under 35 U.S.C. § 103 cannot be sustained.

The rejection under 35 U.S.C. § 102(b) and
alternatively under 35 U.S.C. § 103

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We reverse the rejection of appellant's claims on each of the specified statutory grounds.

This panel of the board fully considered the entirety of the disclosure of the Marto and Lepere article, supra. Consistent with that assessment, which we incorporate herein, the reasonable conclusion that we can reach is that this document alone neither teaches (35 U.S.C. § 102) nor suggests (35 U.S.C. § 103) a reversal of trend less than 2°C on the initial ascent, a particular feature of appellant's method of cooling a surface by nucleate boiling as expressly set forth in claim 1.

REMAND TO THE EXAMINER

This application is remanded to the examiner to consider the following matters and take appropriate action.

1. Claim 3 improperly depends from canceled claim 2.

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2. Claim 5 appears to be drawn to a double inclusion of subject matter already present in claim 1.

3. The claims in a number of instances include words of degree, e.g., in claim 1, line 9, "substantially" flooded; in claim 3, lines 2,3 and claim 34, lines 2,3, "significant" portion; claim 35, line 2, "substantially" 60 μm ; and claim 36, line 2, "substantially" 40 μm . When a word of degree is used, it must be determined whether an underlying specification provides some standard for measuring that degree. See Seattle Box Co., Inc. v. Industrial Crating & Packing, Inc., 731 F.2d 818, 826, 221 USPQ 568, 573-74 (Fed. Cir. 1984). The examiner should assess each of the noted terms in the context used, and as they might be understood by one skilled in the art at issue, to ascertain whether they are each definite in meaning.

In summary, this panel of the board has:

reversed the rejection of claims 1, 3 through 7, 9, and

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34 through 36 under 35 U.S.C. § 103 as being unpatentable over
Reeber in view of Chu, and vice versa, and the Marto and
Lepere article and, optionally, the Hesketh dissertation; and

reversed the rejection of claims 1, 3 through 7, 9, and
34 through 36 under 35 U.S.C. § 102(b) as being anticipated
or, in the alternative, under 35 U.S.C. § 103 as obvious over
the Marto and Lepere article.

Additionally, we have remanded the application to the
examiner to assess matters discussed above.

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The decision of the examiner is reversed.

REVERSED AND REMANDED

IRWIN CHARLES COHEN)	
Administrative Patent Judge)	
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)	BOARD OF PATENT
JOHN D. SMITH)	APPEALS
Administrative Patent Judge)	AND
)	INTERFERENCES
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JENNIFER D. BAHR)	
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